Of

The Nervous System.

I. As ye Functions of Sense and Motion, which comprehend so many of ye Functions of ye animal Oeconomy, depend on ye nervous System; the Study of this must be of ye utmost importance in ye Study of ye general Oeconomy and its particular Functions.

II. In ye Study of ye nervous System, it is in ye first place necessary to learn what truly happens there, and this we shall think of more importance than to explain how it does happen. Upon this Plan ye following Propositions are drawn up.

A general View of the Nervous System.

III. The nervous System consists of y medullary Substance of y Brain, Cerebellum, Medulla Oblongata & Spinalis, and of y same substance continued into y Nerves and by them distributed to many different parts of y Body.

IV. The whole seems properly distinguished into these four parts. —

1st: The medullary Substance contained in the Cranium & vertebral Cavity, y whole of which seems to be under a fibrous arrangement, but without y several fibres being seperated by any sensible enveloping Membranes.

Whenever we speak of Functions that may be in common to every part of this, we shall speak of y whole under y Title of y Brain, when it is

necessary to distinguish y^e particular parts, we shall take care to avoid ambiguity.

2: The nerves in which y^e same medullary substance is continued, but here more evidently divided into fibres, each of which is seperated from the others by an enveloping Membrane derived from y^e Pia Mater.

3: Certain extremities of these Nerves, of which the medullary Substance for a certain length, is divested of these enveloping Membranes (1) & so situated as to be exposed to y^e action of certain external bodies, and perhaps so modified as to be affected by y^e action of certain bodies only. These we name the Sentient Extremities of y^e Nerves.

4: Certain extremities of y^e Nerves (2) so modified as to be capable of a peculiar Contractility and in consequence of their situation and attachments, by their contraction to be capable of moving most of y^e solid & fluid parts of the Body. These we name y^e Moving Extremities of y^e Nerves. They are commonly named Moving or Muscular fibres.

That ye Muscular Fibres are a continuation of ye Medullary Substance of ye Brain & Nerves has not been shown by ye Anatomists, nor universally admitted by ye Physiologists, but we suppose it now and hope to render it sufficiently probable hereafter.

Are ye Ganglions of ye Nerves to be considered as a part of ye System distinguished by a peculiar Function?

V. These several parts of ye nervous System are every where ye same continuous medullary Substance, uniform in its mixture and general Aggregation, and therefore Motion may be propogated from any one part of it to every other, while ye continuous Substance remains in ye same Condition.

Compression interrupts ye Communication of Motion between ye parts of ye System that lay on different sides of ye part compressed.

VI. In ye living Man there is an immaterial thinking substance or Mind constantly

present, and every phænomenon of thinking is to be considered as an affection or faculty of the Mind alone. But in y^e living Man this immaterial & thinking part of him, is so connected with y^e material & corporeal & particularly with y^e Nervous System, that motions excited in this give occasion to Thought, & Thought however excited gives occasion to new motions in y^e Nervous System. This mutual communication we assume confidently as a fact, but y^e mode of it we do not understand nor pretend to obviate y^e difficulties that attend any of y^e suppositions that have been made concerning it.

VII. The Phænomena of y^e Nervous System ordinally occur in this order. The impulse of external Bodies in motion acts upon y^e sentient extremities of y^e Nerves and gives occasion to Thought, & this we call Sensation. This Sensation according to its kind & various modification gives occasion to Volition or Willing y^e Motion of certain parts of y^e Body,

and this Volition gives occasion to y^e^ Contraction of y^e^ muscular fibres by which y^e^ motion of the part desired is produced. —

This is an example of y^e^ most ordinary case, but we do not say it is y^e^ only case of communication between y^e^ different parts of y^e^ Nervous System.

VIII. As y^e^ Impulse of Bodies on y^e^ Sentient extremities of y^e^ Nerves does not occasion any Sensation unless y^e^ Nerve between y^e^ Sentient extremity & y^e^ Brain be free from compression or other interruption; & as Volition does not produce any Contraction of Muscles unless the Nerve between y^e^ Brain & Muscle be quite free; we conclude from both facts that Sensation & Volition are Functions of y^e^ Brain alone; that Sensation arises only in consequence of external impulse producing motion in y^e^ Sentient extremities of y^e^ Nerves, & this being thence propogated along y^e^ Nerves to y^e^ Brain & that the Will operating only in y^e^ Brain by a motion begun there & propogated along y^e^ Nerves produces y^e^ Contraction of Muscles.

IX. From what is now said we perceive more distinctly y^e^ different functions of y^e^ several parts of y^e^ nervous system formerly distinguished. 1. The sentient extremities are particularly fitted to receive y^e^ impressions of external bodies, & according to y^e^ difference of these impressions to propogate determined motions along y^e^ Nerves which communicated to y^e^ Brain give occasion to Sensation. 2. The Brain (IV. 1.) is a part fitted for & susceptible of these motions with which Sensation & y^e^ whole consequent operations of Thought are connected, & thereby or otherwise is fitted to form a communication between the motions excited in y^e^ sentient & those arising in y^e^ Moving extremities of y^e^ Nerves, often remote and distant from each other. 3. The Moving extremities of y^e^ Nerves are so framed as to be capable of contraction & of having this contraction excited by Motion propogated from y^e^ Brain, and communicated to y^e^ contractile fibre. 4. The Nerves more strictly so called are a collection of medullary fibres each envelloped in its own membrane, & thereby so

seperated from one another as to admit of no communication of Motion from one to y^e^ others, and only of motion along y^e^ continuous medul-lary substance of y^e^ same fibre from y^e^ extremities to y^r^ origin, or contrariwise. —

X. From this view of y^e^ parts of y^e^ Nervous Sys-tem, of their several functions & communication with each other, it appears that y^e^ beginning of Motion in y^e^ animal Oeconomy is generally con-nected with Sensation, & that y^r^ chief effects, y^e^ actions of y^e^ animal Oeconomy consist in and depend immediately upon y^e^ contraction of Moving fibres, & therefore in studying y^e^ Nervous System it will be proper to consider, 1. Sensation, and with that y^e^ function of y^e^ Sentient Extremities. 2. The action of y^e^ Moving Fibres. 3. The com-munication between these or y^e^ functions of the Brain. In considering these three the function of y^e^ Nerves more strictly so called will of course be explained.

Of Sensation.

XI. Sensation may in general be referred to the Mind's being conscious of y^e^ changes which happen in y^e^ Nervous System, but our Sensations may be considered as of two kinds, one arising from y^e^ impression of external bodies which we name Sensations of Impression; the other arising from y^e^ Mind's being conscious of its own actions, of y^e^ motions it excites, or of the like motions excited by other causes, and these we name Sensations of Consciousness.

Sensations of Impression

XII. The Sensations of Impression are very various, but have been generally referred to five Heads or Classes, commonly called y^e^ five Senses, that is, those of Sight, Hearing, Smell, Taste & Touch.

XIII. Of these ye four first are well distinguished, each as forming a particular Class or Genus. 1, by ye natural & qualities of ye external bodies acting. 2. By ye part of ye human body acted upon, generally limited to a small space, and connected with a peculiar organization. 3. By ye sensations arising, in each very various, but at ye same time referred to one Genus; and lastly by this that ye sensation arising gives no Indication of ye nature of ye external body acting, nor of ye mode of its action.

XIV. With regard to ye fifth kind of Sensation, Touch, no such characters concur in establishing one class, & it is only formed by referring to this fifth head every sensation that does not manifestly belong to ye other four. This head of Touch is, as commonly spoken of, found to comprehend sensations which arise from ye impression of bodies of very different natures, qualities and modes of acting. 2. Sensations from Impressions which may be made indifferently on any part of ye Nervous System, & therefore on parts not

connected with any particular Organization.
3. Sensations which have no such generical affinity as XIII. 3. – 4. Sensations which give such indication of ye nature of ye external bodies acting & of their mode of acting, as we acquire in this manner only. 5. Sensations which may arise from Impressions made on any part of ye System, but do not any more than those of ye four Senses, give any Indication of ye nature of ye Bodies acting. 6. Sensations arising from impressions made on a particular part of the System only & therefore depending on a particular condition or organization of such part.
7. Lastly, Sensations which are not of Impression but of Consciousness.
It is therefore necessary to subdivide & arrange what is comprehended under ye general head of Touch.

XV. By Touch we perceive ye impulse of bodies in motion, & thereby acquire our notion of the force or momentum of bodies. The Sensation is varied by ye direction of ye impulse & duration

of impression, & number of y^e parts of y^e body affected at y^e same time, or by their being more or less equally affected. It is thus we acquire y^e Notions of y^e size, figure & consistence of bodies, y^e notions of extension & solidity inseparable from our notion of body.

XVI. These are y^e Sensations most strictly referred to Touch, & from these & from some considerations of y^e other Senses, we conclude that all y^e Sensations are only so many different modes of Touch or perceptions of impulse. The Sensations mentioned XV. may arise from impulse or pressure on almost any part of y^e Nervous System.

XVII. It is owing to y^e Analogy mentioned in y^e last Paragraph that so many different Sensations have been comprehended under the head of Touch.

XVIII. By y^e impulse of external bodies variously modified we receive y^e Sensations of

Puncture, pressure, distension, distraction, contorsion, Laceration &c &c., & like Sensations sometimes arise from internal Impressions whose mode of Impulse is not evident.— May we conclude from y^e Sensation that y^e impression is y^e same?

XIX. From certain external applications of Bodies in a fluid form, distinguished by their chemical qualities & whose mechanical properties are unknown we receive in some cases, Sensations resembling puncture, incision, laceration or other Sensations attending Solution of Continuity by mechanical powers, but in other cases y^e peculiar Sensations of itching and smarting without reference to any external Agent. These tho' commonly referred to the general head of Touch may be considered as constituting a peculiar Sense of chemical Acrimony. It is in common to y^e whole Nervous System only with different degrees of Sensibility as y^e extremities of y^e Nerves are more or less covered by other parts interposed.

The matters operating here are very often the same with those that produce Smell & Taste. All of them are distinguished by chemical qualities, & to their operation on these three Senses y^e same circumstances are necessary as in y^e mutual action of bodies in Chemistry. — From y^e Sensation of puncture arising from chemical Acrids, may we suppose their mode of impulse to be analogous to that of the mechanical acrids?

XX. The Sensations of Heat & Cold always referred to Touch we consider as belonging to a particular Sense very different from that of XV, in this respect, that y^e Sensation gives no indication of y^e mechanical properties, or of y^e action of the matter producing it.

XXI. In y^e Sensations XIX & XX, & in some others attended with pain, we hardly distinguish the peculiarity of y^e Sensation & attend to it as painful only.

XXII. Many Sensations are constantly attended with propensities, & therefore form a peculiar Set of Sensations. This is peculiar to them that very often we do not distinguish ye Impression from ye propensity & very often we are only conscious of ye last. — These propensities are of two kinds, some are directed to an external object and are called Appetites, as these of hunger, thirst and lust, others are directed to exciting Motions of ye body itself only, chiefly for ye purpose of excretion. The Sensations giving occasion to these several propensities are often little perceived, & it is often uncertain how they are produced, whether they are from external or internal Impressions and whether they are Sensations of Impression or of Consciousness.

Sensations of Consciousness.

XXIII. The Sensations of Consciousness may be referred to these Heads. 1. Sensations arising from ye diminution or absence of Impression. 2. The Sensation of a perception, or that by which

we acquire y^e Notion of our existence & identity.
3. The Sensations arising from y^e state of Thinking.
4. Sensations arising from y^e exercise of Volition.
5. Sensations arising from actions or from the motions of different parts of y^e Body. 6. Sensations arising from y^e State of action in general or in particular.

Under these heads a considerable number of Sensations are comprehended, of which we cannot here enter into y^e detail.

Laws of Sensation.

XXIV. The impressions producing Sensation may be distinguished as external & internal. The first are those of bodies external or extraneous to y^e human body, whether they act directly on y^e external parts, or are conveyed into the internal & act there, & whether they are entirely from without, or if they are preternatural bodies generated or formed within. — The internal impressions are y^e actions of y^e body itself which return or reflect an impulse on the

Nervous System. It is often difficult to distinguish ye Sensations of internal Impressions, from ye Sensations of consciousness.

XXV. To Sensation from Impression a certain force of Impression is necessary & below this no Sensation is produced. This force is also limited on ye other hand as in a high degree it destroys the organ & in degrees approaching to this, rather a general Sensation of pain than any particular one is produced.

XXVI. Within these limits our Sensations are not exactly proportioned to ye force of Impression, but for ye most part relative to ye change that is produced in ye Nervous System, so that a Sensation often seems strong or weak as it is stronger or weaker than that which has immediately preceded it. For ye same reason ye limits XXV, are very variable.

XXVII. Different Sensations do not necessarily imply a different kind of action producing each, but sometimes they arise merely from a different

Query. — Does K. excavation
stuff mean
F. K. A.

degree of force in y^e same.

XXVIII. It appears that y^e diminution of the force of Impression is sometimes active with regard to y^e Nervous System, & therefore that y^e Motions of our System depend more upon Sensation than upon Impression.

XXIX. To Sensation from Impression a certain duration of Impression is necessary. —

XXX. If y^e force & duration of Impression are in a due degree, y^e sensation often remains for some time after y^e Impression has ceased.

XXXI. The Mind admits but of one Sensation at one time, so that of two Impressions made at the same time, y^e one only is perceived, y^e other is not or if y^e Mind as in XXX is occupied by a former Sensation a present Impression is not perceived.

XXXII. The Mind's resting on one Sensation is called attention. This like y^e duration XXIX, is

necessary for giving an Impression its full Effect.

XXXIII. The Mind seems to be determined to Attention by y^e Force of Impression, by y^e pleasure or pain arising from it, by y^e degree of emotion or passion produced by these, & lastly by these Impressions being more or less related to y^e person feeling.

XXXIV. Tho' y^e Mind admits but of one Sensation at one time, several Impressions may act at y^e same time in producing Sensation. Such is y^e case when y^e Sensations which would be produced by seperate Impressions are all of the same Class or Genus, as in y^e cases of Colour, Sound, Odour & Taste.

XXXV. In each of these y^e Impressions correspondent to several Species coalesce in producing a single Sensation, which is always a Neutral or different from either of y^e seperate Sensations.

XXXVI. In all Cases of such Union it may take place either when y^e Impressions are exactly

synchronous, or when y one succeeds y other before y Sensation of y first XXX has ceased.

XXXVII. Tho' y Motions excited in y Nerves by Impression remain for some time as in XXX, they must be supposed to become continually weaker & at length to cease & therefore y Sensation also.

XXXVIII. It is observed that y same Impressions soon repeated do not produce y same Effect as before, but continually less. Hence all new Impressions are cæteris paribus strongest.

XXXIX. Impressions being given their Effects in producing Sensation are different in different persons, & in y same person at different times. This must arise from y difference of y Body's acted upon. The chief difference occurring in these seem to be y following. 1. The state of y Tegument or other parts interposed between y impressing body & y medullary Substance. 2. The State of y medullary Substance itself, as it appears in Age, Sex & Temperament.

3: The State of Tension in ỹ medullary Substance by ỹ Blood Vessels connected with it. — 4th: The State of it produced by heat. — 5th: The State of it produced by former Impressions — 6th: The State of ỹe Nerves along which ỹ Motion is propogated. — 7th: The State of ỹe Sensorium — 8th: The State of attention.

XL. Different parts of ỹ Body are sensible by the Nerves distributed to them & by ỹe Conditions (XXXIX) of these Nerves, but Anatomy does not always certainly determine ỹ distribution of ỹe extremities of ỹe Nerves & therefore ỹ sensibility of several parts is chiefly to be ascertained by Experiment. — The Experiment is however also fallacious.

XLI. Particular Sensations arise from Impressions on certain parts only. — 1st: Because the sentient extremities are so situated as to lye exposed to ỹe Action of certain external Bodies only — 2: Because ỹ sentient extremities are connected with an organ that increases ỹ force of ỹe external Agent or modifies it in ỹ manner necessary to a determined Impression. — 3: Because ỹe fibres of ỹ sentient

extremities by their size or tension are fitted to be acted upon by certain external Bodies only. 4th: Because y^e sentient extremities are by y^e Constitution preserved in a certain State that renders them invisible to a change. 5th: Because y^e sentient extremities have such Connection with y^e rest of y^e System as produces particular Effects from Impressions made upon y^m.

XLII. Different Sensations are accompanied with different Judgements concerning y^e Bodies making Impression, & y^e part of our body upon which it is made.

Some Sensations are referred to external bodies at a distance, others to external bodies in contact, & others only to y^e feeling body itself.

In y^e last case y^e Sensation is sometimes referred to y^e part upon which y^e Impression is made, with regard to external parts, very accurately, with regard to y^e internal much less so, & commonly y^e internal Impression or Sensation of it is referred to y^e correspondent external part with some obscure distinction between internal & external.

In some Cases y^e Sensation is not referred to the

part upon which y^e Impression is immediately made, but to a distant more sensible part to which a motion is propogated from y^e part impressed.
Sometimes a Sensation is referred to a part from which Motions, producing Sensations, used to proceed along y^e Nerves, now under an unusual Impression.
The Sensations of Conciousness are seldom with any accuracy referred to particular parts & only indistinctly to a whole Membrane, seldom to external Agents.

XLIII. We are disposed to combine our Sensations as united in one object to form y^e Notion of individuals of Substance of Identity & thus we acquire what we call Complex Ideas. The chief of these is our notion of self or our own Identity. The parts of complex Ideas are associated.

XLIV. We compare our several Sensations & from thence acquire new Sensations of Relation, y^e chief of which are those of Resemblance, Difference, and Contrariety of Position, in place & time, of Cause & Effect, of Means & Ends. It is especially Relation

that associates Ideas.

XLV. The most of our Sensations nearly all of them are either painful or pleasant.

XLVI. The Terms of painful & pleasant, agreeable & disagreeable are generical Terms comprehending a great many Species to which y^e generic Terms should not be promiscuously applied. — I think it may be proper to distinguish on y^e one hand the agreeableness of figure, y^e deliciousness of taste & y^e pleasure of ichery. — and on y^e other hand the disagreeableness of figure, y^e uneavinefs of figure & y^e pain of a wound. — There is a foundation for establishing different orders of these Sensations, but y^e fixing y^e limits between these & assorting the several Species may be difficult, & we cannot be certain of applying y^e Terms with strict propriety.

XLVII. In general Sensation of Action within certain limits are always agreeable, & therefore y^e want of Sensation, imperfect & indistinct

Sensations, are always disagreeable. Inaction of every kind, ye Sensations of Debility & of Difficulty are always uneasy.

XLVIII. In particular Sensations, their being uneasy, pleasant or painfull often depends on the degree of force in ye Impression modified by ye Sensibility of ye System.

XLIX. As Impressions by being repeated give weaker Sensations, Impressions at first painfull may be changed into pleasant, & ye pleasant into uneasy, hence ye desire of variety, ye pleasure of novelty & ye desire of increasing ye force of pleasant Impressions.

L. There is a condition of Impressions rendering them agreeable or disagreeable which we cannot certainly refer to their force & this condition we call ye quality of Impressions.

LI. Impressions are oft rendered agreeable or disagreeable by Combination, Relation & Succession.

LII. The Force of Sensation is as —
The Impression is new & unexpected.
The Force of Impression,
The Quality of Impression,
The Sensibility of y^e Organ or Sensorium,
The Habit of y^e System,
The Pleasure or Pain accompanying it,
The Emotion produced by it,
The State of attention.
— Several of these Conditions concur, often
ballance one another, & must be taken together.

LIII. When ~~Sensations~~ Sensations formerly received are
again renewed by y^e same Object, it is often with
a Sensation or Consciousness of their having
been formerly received. — This we call Reminis-
cence. It is y^e chief Foundation of our notion
of Identity.

LIV. Notions formerly received can be renewed
without y^e presence of y^e Object which formerly
gave occasion to them, & if this is with a
Sensation of a difference between y^e two Notions,

Any Matter that is Imaginable?

Is it not an Immutable as LIV.

I. E. Sr.

and particularly of a consciousness of y^e absence of y^e Object, such a renewed Notion is called an Idea and y^e Faculty by which it is renewed is called Memory.

IV. Notions formerly received may also without y^e presence of y^e Object be renewed in such a manner, that y^e Mind does not perceive y^e difference of y^e one case from y^e other, & therefore such renewal is always with y^e persuasion of y^e presence of y^e Object. The Faculty by which such renewal is made, is called y^e Imagination more strictly.

IVI. The causes of Reminiscence & Imagination are difficultly assigned. — Memory we can refer to y^e Association which y^e marking of Relation produces & it is faithfull to that association in all its circumstances.

IVII. Memory & Imagination renew distinctly y^e Ideas of Seeing & Hearing. All others are renewed imperfectly or not at all. But all others may be associated with y^e Sensations or Ideas of Seeing & Hearing & these become signs of the

others, with this Effect that ye Memory in renewing
ye Signs, do far renews ye Ideas connected with them
as to make their several Relations & Associations to
renew ye general Idea of Pleasure or Pain that
attended them & particularly to renew ye Emotions
of ye Mind or ye Motions of ye Body, which they formerly
produced.

LVIII. Memory is different in different persons and
in ye same person at different times of Life & on
different occasions. — The Causes of this seem in general
to be — Different States of ye Sensorium — Different
Forces of single Sensations. — Different Force of
Relation & Sensations & ye making their Relation
being more or less frequently repeated.

LIX. Certain Sensations can be produced by different
Causes.

LX. No Sensations or Ideas arise in ye Mind, without
a previous changeing ye State of ye Body. Memory &
Imagination renew only ye Ideas or Sensations
originally
formerly received & with ye Conditions expressed.

LXI. Certain Impressions & certain States of the Body analogous to y States which produce the Sensations of Consciousness may both act upon the nervous System without producing Sensation.

Of the Action of Moving Fibres.

LXII. The moving Fibres (IV: 4) so far as yett known are of one kind only, and y^e^ same every where as in the most commonly known Muscles.

Hence y^e^ Terms moving or muscular Fibres, are of y^e^ same import.

LXIII. A muscular Fibre is supposed to have a particular Organization different both from that of simple solid Fibres, & from y^t^ of medullary Fibres, in any other part of y^e^ nervous System, but in what y^t^ peculiarity of organization consists is not yett exactly ascertained —

LXIV. A muscular Fibre is endued with a Contractility which is different from y^t^ of y^e^ simple Solids, or other common Elasties, especially in this that its Action is excited by Causes which do not affect these others. It is excited by y^e^ Extension of y^e^ Fibre and a Contraction is produced whilst y^e^ stretching power continues to be applied. It is also excited by

Has not the heart of a frog, as well as that of some other animals been known to retain some of its movements long after the animal has been dead?

R. R. Jr.

various Applications whose Mode of Action we do not perceive; but we know them to be such as do not affect common Plastics.

In respect of those Causes by which it may be excited, y^e Contractility of muscular Fibres has been called Irritability.

Whatever excites y^e Contraction of muscular Fibres is called a Stimulus

LXV. The Force of Contraction in muscular Fibres is often much greater than y^t of y^e Causes exciting it.

LXVI. The Contractility of muscular Fibres (LXIV. LXV) appears especially in living Bodies, ceases with Life or soon after & is probably never produced but with Life — Hence by some Writers it is called y^e "Vital Power of Solids", & y^e Solids endued with it "a living Solid".

LXVII. The Contractility seems to belong to muscular Fibres in some measure independently with their Connexion with y^e other parts of y^e animal System. This power of Contractility therefore hath been with

respect to muscular fibres called a *Vis insita* and we shall call it y^e *inherent Power*

LXVIII. The Contraction of muscular fibres can be excited by applications to other parts of y^e nervous System as well as to Muscles themselves, & as y^e Effects of applications made to other parts of y^e nervous System can be prevented by Ligatures made upon y^e Nerves between y^e place of application & y^e Muscle to be moved, it is supposed y^t y^e Contraction of muscular fibres can be excited by a power communicated to them by a Motion propogated along y^e Nerves. —

This power is called *"The Nervous Power."*

LXIX. The Nervous power is most commonly determined to Motion by y^e *Will* — This we suppose to act in y^e Brain only & to depend upon Sensation and other modifications of Thought —

This power chiefly to be referred to y^e Mind, and acting in y^e Brain only, we call y^e *Animal Power*

LXX. — The Facility with which y^e inherent power can be excited — and y^e force excited by it in

contraction are to be distinguished –
The first we name the Mobility.
The last – the Contractility of Fibres.
Both have been confounded under y^e^ Name of Irritability.

LXXI. The Mobility or Contractility of muscular Fibres can both of them be increased or diminished by various means. – The means of increasing y^e^ Contractility of Fibres are called "Tonic Powers"
Those that diminish y^e^ Mobility of Fibres are called "Sedative Powers."

LXXII. The inherent power is supposed to be stronger, more movable & more permanent in certain muscular Fibres than in others.

LXXIII. The inherent power can be excited, increased or diminished by certain Applications made either to y^e^ Muscles themselves or to y^e^ Nerves connected with y^m^, & in either case y^e^ Effect of y^e^ Application is so exactly y^e^ same as to make us conclude that y^e^ matter in y^e^ Nerves & muscular Fibres is of y^e^ same kind.

LXXIV. The muscular fibres are sensible to various Impressions & are otherwise Organs of y^e sensations & Consciousness (XXIII. 6:) & from this it is presumed that they consist of y^e same matter that is y^e subject of sense in other parts of y^e nervous System —

LXXV. From LXXIII. LXXIV. & other Considerations it is probable that y^e muscular fibres are a continuation of y^e medullary substance of y^e Brain & Nerves, as alledged (IV.-4-)

LXXVI. Tho' y^e muscular fibres consist of y^e same kind of Matter, as is also in y^e Nerves, the latter show no Contractility because they are not under y^e same circumstances & have not y^e peculiar Organization (LXIII) of y^e former.

LXXVII. The nervous (LXVIII.) & y^e inherent power (LXVII) may subsist for some time without any connection of y^e nerve or muscle w^t y^e Brain & they subsist also in entire Bodies, for some time, seemingly, after life has ceased. Both powers however are seemingly of equal duration in these respects and

neither power seems to subsist long but in entire & living Bodies.

LXXVIII. In entire & living Systems ye inherent power seems to have a considerable dependence upon ye nervous & both perhaps have a dependence upon ye animal (LXIX)

LXXIX. The Contraction of muscular fibres does not depend immediately on ye Motion of ye Blood

LXXX. The Contraction of a muscular fibre does not depend on ye Inflation of Vesicles or other such analogous Structures.

LXXXI. As ye force of Cohesion in ye muscular fibres of living Animals is much greater than in those of dead ones, it is probable from this & other Considerations that ye cause of muscular Contraction is an increase only of ye same power that causes their Contraction as simple solids.

If this is true it will explain why ye force of Cohesion of muscular fibres is greater than that of ye medullary fibres in any other parts of ye nervous

System, tho' both kinds of fibres, by (LXXV) consist of ye same kind of matter. —

LXXXII. — In living & healthy Animals, ye muscular fibres have a constant tendency to Contraction, and this is what we call their Tonic Power

LXXXIII. The tonic power of Muscular fibres necessarily supposes their being constantly in a state of Extension, & as ye Extension of muscular fibres by (LXIV) proves a Stimulus to their Contraction, we suppose ye tonic power will, cæteris paribus, be in proportion to ye degree of Tension.

LXXXIV. The muscular fibres are kept constantly in an extended state, by ye action of antagonist Muscles, by ye weight of ye parts they sustain, by fluids distending ye Cavities they surround, & by their Connection with such distended Cavities, particularly ye Blood Vessels.

LXXXV. If ye inherent power as mentioned in (LXXVIII) is in dependance upon ye nervous & animal powers and these may be increased or diminished by various causes,

the inherent tonic power must be, in some measure, in proportion to y^e^ nervous & animal Powers. —

LXXXVI. The force of Contraction of muscular fibres will be always as y^e^ force of Stimulus & y^e^ strength of nervous, animal & inherent power taken together.

LXXXVII. The Mobility of muscular fibres seems to be increased by whatever weakens their tonic power & therefore by y^e^ Diminution of their Tension as mentioned in (LXXXIII) & by weakening y^e^ nervous & animal powers in (LXXXV).

LXXXVIII. If y^e^ tonic power of any muscular fibres depends more upon their Tension than upon y^e^ nervous or animal powers, such fibres will be more affected by Changes of Tension than by stimulant tonic or sedative Powers; & on y^e^ contrary if the tonic power of any fibres depends more upon the nervous or animal Powers, such fibres will be more affected by Changes in y^e^ State of these powers than by y^e^ Changes in y^e^ State of Tension —

LXXXIX. The ordinary Contraction of muscular Fibres is disposed spontaneously to alternate with a relaxation & Extension of y^e same.

XC. In y^e straight Muscles & in y^e Heart, y^e alternate Contractions & Extensions readily appear & even tho' a Stimulus is constantly applied, but in other muscular Fibres surrounding Cavities, as in y^e alimentary Canal, Bladder of Urine &c, y^e alternate Motions do not appear unless a portion of y^e Fibres is cut out, & separated from y^e rest.

XCI. From y^e different State of Muscles contracted by inherent power, whilst y^e Member they sustain is moved by external force, from y^t of y^e same Muscles contracted by y^e power of y^e Will, we perceive, y^t there may be a state of relaxation in Muscles without their Extension.

XCII. When Muscles acted upon by preternatural Causes are contracted with unusual velocity or force and when such Contractions alternating with relaxations & Extensions, are thus frequently contracted, such

Motions are called Convulsions

XCIII. There is a state of ye Contraction of muscular fibres that is not disposed spontaneously to alternate with Relaxation, & which ye fibres do not easily yield to extending Power applied — Such a Contraction is called Spasm

XCIV. If ye Contraction of muscular fibres is exerted with much force & such Contraction is frequently repeated or even if with a moderate force ye Contraction is repeated frequently for a certain time, ye Contraction becomes uneasy & weaker.

But within these bounds of force, frequency and duration, ye Contraction of Muscles by being repeated is performed with more facility & force.

XCV. Are not ye Contractions produced by ye action of ye animal power, those which more especially are liable to become uneasy & weak by Repetition?

Of the Functions of the Brain.

XCVI. From ye Effects of Ligatures made upon the Nerves or other means of destroying their continuity, it appears that in their entire State, motions may be communicated from the Brain to the other parts of the nervous System, & also from the latter to ye former, & from ye same Experiments it appears that the Brain IV. 3, is ye organ of Sensation & Volition as explained IX. 2. — This is confirmed by the Effects of organic Affections of ye Brain on ye intellectual Faculties.

XCVII. As Impressions made upon any part of the nervous System are communicated along ye course of ye nerve upon which ye Impression is made directly to ye Brain & hardly to any other part of ye nervous System but by ye Intervention of that organ: as 2. many Impressions thus communicated are by LXI not accompanied by Sensation or Volition & may therefore be

presumed to be merely mechanical & as 3 these mechanical communications are variously modified by different conditions of y^e Brain, it appears that the Brain is a corporeal organ susceptible of various conditions & thereby of considerable Influence in most of the Phænomena of y^e nervous System.

XCVIII. The Brain seems by its organization to be disposed to y^e alternate States of rest & activity, of sleep & watching, but wherein this organization consists it is difficult to discover.

XCIX. Tho' for certain purposes of y^e Economy a fluid is secreted in y^e Brain; it does not appear that Sleep & Watching depend upon the State of this Secretion, or upon y^e less or greater quantity of such a secreted fluid present in y^e Brain & Nerves.

C. Tho' a certain Compression of y^e Brain can produce a State of y^e System resembling sleep, y^e state is in some respects different from ordinary Sleep, & it does not appear that natural & ordinary Sleep depends upon any Compression of y^e Brain.

CI. As it is probable that Sleep & Watching do not depend upon ye different quantity of ye matter of ye nervous power or upon any Causes interrupting its motion while ye matter remains ye same, it seems probable that those States depend upon ye nature of ye nervous power being capable of becoming more or less moveable & that it is especially in ye Brain susceptible of those different Conditions, & at least that it is attended therewith more general Effects in the whole System.

CII. It appears that a certain degree of Heat, the most part of Sensations, Impressions analogous to those producing Sensation, & ye Impetus of the Blood in ye Vessels of ye Brain are the chief Causes of the moveable State of the nervous power in ye Brain and therefore of Watching —

CIII. It appears also that Cold, ye want of Sensations & Impressions, sedative Sensations & Impressions, Evacuations, Relaxation, & all violent frequent or long continued exercise of ye animal power induce Sleep, & diminish the moveable State of the nervous power in ye Brain. —

CIV. As most of those Causes CII, excite Motion in the Brain, & most of those CIII, diminish it, it is probable from ye Phænomena of Sleep & Watching that ye nervous power in ye Brain is truly capable of different States or Degrees of Mobility which we shall call its State of Excitement and Collapse, but without intending by these Terms to express or determine any thing with respect to ye nature of ye nervous power or wherein its different states consist.

CV. The Excitement of ye Brain appears to be in different degrees on different occasions. It seems to be greatest in different Maniacs endowed with uncommon strength, resisting the force of most Impressions & ye most difficultly admitting Sleep—

CVI. A second or lower degree of Excitement is the ordinary State of watching in Men in Health, where the Excitement is total with respect to the Brain & readily admits of Collapse or Sleep. But this Excitement may be in different degrees with respect to the rest of ye System & is expressed by Vigor or Debility, by Courage or Timidity, by Alac-

-rity or Sluggishness & by Gaity or Sadness.

CVII. In still lower degree of Excitement, or the first degree of Collapse is in y^e^ case of natural Sleep, in which the Collapse takes place in y^e^ Brain so as very entirely to interrupt the animal Functions, but with the subsistance of y^e^ vital & natural only somewhat weakened – Even with respect to the animal Functions the Collapse is more or less complete as the Sleep is with or without dreaming, & as the dreaming is more or less active.

CVIII. In still greater degree of Collapse takes place in y^e^ case of Syncope; in which the Brain is so much & so totally collapsed as not to be sufficient to y^e^ vital Functions. But we presume that there is still some degree of Excitement while y^e^ Brain can be acted upon by the Stimuli that act only on vital powers & while its usual Excitement is still recoverable by such Stimuli. If the Collapse is more complete & irrecoverable, it is y^e^ state of death.

That Syncope & Death are owing to Causes w^ch^ produce a Collapse of the Brain is probable from

the nature of many of those causes & the circumstances of their operation —

CIX. It may now be observed that Sleep & Watching do not depend so much upon the degree of Collapse & Excitement with respect to y^e^ whole System as upon those conditions being more or less complete with respect to y^e^ Brain. But in assigning the causes of Sleep & Watching we have mentioned the principal causes of the different States of Excitement in other respects. —

It is proper in the next place to consider the different states of the other parts of y^e^ nervous System, which may be analogous to those of the Brain or may influence them.

CX. In the Nerves strictly so called IV. 2, we do not know that the nervous power suffers any change but what is exactly correspondent to the state of the same in y^e^ Brain & y^e^ only difference to be taken notice of in y^e^ Nerves is their being more or less free or interrupted in admitting the Communication of Motion between their Origin and

Extremities —

CXI. In the sentient Extremities of y^e^ Nerves IV. 3 a different State arises from the several Causes that we said before XXXIX, 2. 3. 4. 5, might give a different degree of Sensibility & thereby determine the Effects of Impressions communicated to y^e^ Brain. Are not these different States of the sentient Extremities somewhat analogous to the States of Exitement & Collapse in the Brain?

CXII. The moving Extremities of muscular Fibres IV. 4. may also be in different Conditions with respect to y^e^ nervous power in them, how far this may arise from different Circumstances in their peculiar Organization, we are uncertain, we can perceive more clearly that their Condition may be varied by y^e^ Causes affecting the state of their tonic power, LXXXIII, LXXXIV, by the power of habit, XCIV, & by their connection with topical Stimuli, as in y^e^ case of the propensities (XXII), while these are Causes which may affect any of the moving fibres, it is to be observed y^t^

there are certain portions of them, as the muscles of voluntary Motions, y^e muscular fibres of the arterial System, those of the alimentary Canal & perhaps some others which are exposed to the action of peculiar Causes, or to y^e general Causes more than other portions of y^e same fibres.

Are not these different states of y^e muscular fibres also somewhat analogous to y^e states of Excitement & Collapse in y^e Brain CIV. & perhaps to those of the sentient Extremities, CIX or CX.

CXIII. As upon almost every supposition there is a mutual pressure upon y^e origins & several Extremities of the Nerves, it is sufficiently probable that as y^e conditions of either are changed, it must produce some change in y^e other.

CXIV. The Excitement of y^e Brain is to be considered as of two kinds, y^e one with respect to y^e Vigour, y^e other with respect to y^e Mobility, and this last with respect to Sensibility & Irritability may affect the one more than the other. These differences appear in Age, Sex, & Temperament

and in the same person upon different occasions, & the conditions may be variously seperated & com-bined, but y^e Causes are difficultly ascertained & the Causes always obscure.

CXV. The action of the Brain is excited not only by y^e Causes of Excitement above mentioned, directly, but often also indirectly or secondarily by the various causes of Collapse.

CXVI. The action of the Brain is determined & regulated by Custom & Habit. See above XXVI, XXXVIII, XXXIX, XLIII, XLIV, XLIX, LII, LVI & LVIII, 4. for y^e Effects of Custom on Sensation, & XCIV for one Effect of y^e same on y^e action of moving Fibres. It is now to be observed further, 1. that Custom determines y^e degree of tension LXXXIII, that is necessary to y^e action of muscular Fibres - 2. that Custom associates motions with certain Impressions not otherwise their Causes, 3. that Custom associ-ates different Motions, so that they cannot be seperately performed, 4. That Custom determines the order of succession in associated Motions, the

velocity with which each is performed, & with which they succeed one another – 5th & lastly, Custom establishes the periodical return of certain Motions not necessary to the Oeconomy & fixes the exact period of certain motions, which by y^e laws of y^e Oeconomy are disposed to return at intervals. It will be obvious that in 2, 3, 4 & 5, Custom operates in determining & regulating the Action of y^e Brain.

CXVII. The Action of y^e Brain is determined to particular Muscles or moving Fibres – 1st by Stimuli applied to certain parts, tho' producing no Sensation, 2: By y^e Condition of certain parts, producing no Sensation, but by a Condition analogous or like to that which produces a Sensation of Consciousness. 3. By a Sense of pain or uneasiness arising from certain parts – 4th By y^e Irritability of certain parts, greater than that of others – 5. By a determination rendered more constant by Stimuli & Habit – 6: By Irritation – 7th By Propensity – 8th By Will.

CXVIII. The Action of y^e Brain is withdrawn from certain parts or ceases with respect to them, by

Causes contrary to some of these, CXVII, & it is often interrupted by causes interrupting y^e^ Communication of Motion from one part of y^e^ nervous System to certain others.

CXIX. Most of the communications of Motion, between y^e^ different parts of y^e^ nervous System, which have been mentioned as instances of particular sympathy between these parts, may, as we think be better explained by supposing a general Action of y^e^ Impression upon y^e^ Brain, & y^e^ particular Effects are owing to y^e^ Causes of determination or withdrawing CXVII, CXVIII, than by supposing any real Connections between y^e^ Nerves of y^e^ parts impressed & acting either in their Course or Origin —

CXX. These are y^e^ chief Laws of y^e^ nervous System they might perhaps be further illustrated & more exactly ascertained by a more particular Inquiry into y^e^ nature of this System, & those powers &^c^ operate in it, but we are not so confident in our opinions on this subject, or of the application they will admit of, as to deliver them here. ——